

CLAIMS

We claim:

1. A method of measuring the throughput of transmissions from a station to an access point over a wireless local area network, the method comprising:
 - sending messages from the station to the access point during a test period,
 - wherein the messages are sent as data frames;
 - receiving messages sent from the station at the access point during the test period;
 - sending acknowledgements from the access point to the station for messages received by the access point,
 - wherein acknowledgements are sent as control frames for each message received by the access point;
 - receiving acknowledgements at the station from the access point for messages received by the access point; and
 - determining a throughput for the test period based on the acknowledgements received at the station from the access point during the test period.
2. The method of claim 1, wherein sending messages includes:
 - sending a first message from the station to the access point, and
 - determining if an acknowledgement for the first message has been received at the station.
3. The method of claim 2, wherein sending messages includes:
 - resending the first message if the station fails to receive an acknowledgement from the access point and if a retry limit has not been reached.
4. The method of claim 3, further comprising:
 - counting a retry for each message that is resent.

5. The method of claim 2, wherein sending messages includes:
counting a frame loss for the first message if the station fails to receive an acknowledgement from the access point and if a retry limit has been reached.
6. The method of claim 2, wherein sending messages includes:
sending a second message from the station to the access point after receiving an acknowledgement at the station for the first message or counting a frame loss for the first message.
7. The method of claim 1, wherein determining a throughput for the test period further comprises:
determining the throughput in bits per second based on the test period, the number of acknowledgements received at the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.
8. The method of claim 1, further comprising:
sending a request to send frame from the station to the access point before sending each message; and
receiving a clear to send frame at the station from the access point before sending each message.
9. The method of claim 1, wherein each message includes a header having a destination address set to the access point, a basic service set identification address (BSSID) set to the access point, and a source address set to the station.
10. The method of claim 9, wherein each message further includes a header having a destination service access point set to a null service access point.
11. The method of claim 1, further comprising:

sending the messages received by the access point to the station;
receiving the messages at the station from the access point;
determining a throughput from the access point to the station for the test period based on the messages that are received by the station from the access point during the test period.

12. The method of claim 11, wherein determining a throughput from the access point to the station for the test period further comprises determining the throughput in bits per second based on the test period, the number of messages received at the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.

13. The method of claim 1, further comprising displaying at the station the determined throughput.

14. The method of claim 1, wherein data frames and control frames are sent according to the 802.11 standard, and wherein the acknowledgements are standard 802.11 ACK frames.

15. The method of claim 1, wherein data frames and control frames are sent and received below a network layer in an OSI model.

16. A method of measuring the throughput of transmissions from a station to an access point over a wireless local area network, the method comprising:

sending messages from the station to the access point during a test period,
wherein the messages are sent as data frames;
receiving acknowledgements at the station from the access point,
wherein the acknowledgements are sent to the station as control frames for each message received by the access point; and

determining a throughput for the test period based on the number of acknowledgements received at the station from the access point during the test period,

wherein data frames and control frames are sent and received below the network layer according to the IEEE 802.11 standard.

17. The method of claim 16, wherein sending messages includes:
sending a first message from the station to the access point, and
determining if an acknowledgement for the first message has been received at the station.
18. The method of claim 17, wherein sending messages includes:
resending the first message if the station fails to receive an acknowledgement from the access point and if a retry limit has not been reached.
19. The method of claim 18, further comprising:
counting a retry for each message that is resent, and
displaying at the station a number of retries counted during the test period.
20. The method of claim 17, wherein sending messages includes:
counting a frame loss for the first message if the station fails to receive an acknowledgement for the first message from the access point and if a retry limit has been reached.
21. The method of claim 20, further comprising displaying a number of frame losses counted during the test period.
22. The method of claim 17, wherein said sending messages includes:
sending a second message from the station to the access point after receiving an acknowledgement at the station for the first message or counting a frame loss for the first message.

23. The method of claim 16, wherein determining a throughput for the test period further comprises determining the throughput in bits per second based on the test period, the number of acknowledgements received at the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.

24. The method of claim 16, further comprising:
sending a request to send frame from the station to the access point before sending each message; and
receiving a clear to send frame at the station from the access point before sending each message.

25. The method of claim 16, wherein each message includes a header having a destination address set to the access point, a BSSID set to the access point, and a source address set to the station.

26. The method of claim 25, wherein each message further includes a header having a destination service access point set to a null service access point.

27. The method of claim 16, further comprising:
receiving messages at the station from the access point,
wherein the access point sends the messages to the station after receiving the messages from the station;
determining a throughput from the access point to the station for the test period based on the messages received by the station from the access point during the test period.

28. The method of claim 27, wherein determining a throughput from the access point to the station for the test period further comprises determining the throughput in bits per second based on the test period, the number of messages

received at the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.

29. The method of claim 16, wherein data frames are at least 29 bytes in length,

wherein control frames are at most 20 bytes in length, and
wherein acknowledgements are 14 bytes in length.

30. A method of measuring the throughput of transmissions from an access point to a station over a wireless local area network, the method comprising:

sending messages from the station to the access point during a test period,
wherein the messages are sent as data frames;

receiving messages sent from the station at the access point during the test period;

sending the messages received by the access point to the station;

receiving the messages at the station from the access point; and

determining a throughput for the test period based on the messages that are sent from the station to the access point and received by the station from the access point during the test period.

31. The method of claim 30, wherein sending messages includes:

sending a first message from the station to the access point, and

determining if an acknowledgement frame for the first message has been received at the station,

wherein the acknowledgement is sent as a control frame from the access point to the station when the access point receives the first message.

32. The method of claim 31, wherein sending messages includes:

resending the first message if the station fails to receive an acknowledgement from the access point for the first message and if a retry limit has not been reached.

33. The method of claim 31, wherein sending messages includes:

counting a frame loss for the first message if the station fails to receive an acknowledgement from the access point for the first message and if a retry limit has been reached.

34. The method of claim 31, wherein said sending messages includes:

sending a second message from the station to the access point after receiving an acknowledgement at the station for the first message or counting a frame loss for the first message.

35. The method of claim 30, wherein determining a throughput for the test period further comprises determining the throughput in bits per second based on the test period, the number of messages sent from the station to the access point and received by the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.

36. The method of claim 30, further comprising:

sending a request to send frame from the station to the access point before sending each message; and

receiving a clear to send frame at the station from the access point before sending each message.

37. The method of claim 30, wherein each message includes a header having a destination address set to the station, a BSSID set to the access point, and a source address set to the station.

38. The method of claim 30, further comprising:
receiving acknowledgements at the station from the access point for
messages received by the access point,
wherein the acknowledgements are sent as control frames for each
message received by the access point;
determining a throughput from the station to the access point for the test
period based on the number of acknowledgements received at the station from the
access point during the test period.

39. The method of claim 30, wherein sending and receiving data frames and
control frames is accomplished below a network layer.

40. The method of claim 39,
wherein sending and receiving data frames is accomplished at a data link
layer, and
wherein the data link layer operates according to an IEEE 802.11 standard.

41. A method of measuring the throughput of transmissions over a wireless
local area network having a station and an access point, the method comprising:
sending messages from the station to the access point during a test period,
receiving messages sent from the station at the access point during the test
period;
sending ACK frames from the access point to the station for messages
received by the access point,
receiving ACK frames at the station from the access point for messages
received by the access point;
sending the messages received by the access point to the station;
receiving the messages at the station from the access point;
determining a throughput from the station to the access point for the test
period based on the ACK frames received by the station from the access point
during the test period; and

determining a throughput from the access point to the station for the test period based on the messages that are sent from the station to the access point and received by the station from the access point during the test period.

42. The method of claim 41, wherein sending messages includes:
sending a first message from the station to the access point, and
determining if an ACK frame for the first message has been received at the station.

43. The method of claim 42, wherein sending messages includes:
resending the first message if the station fails to receive an ACK frame from the access point for the first message and if a retry limit has not been reached.

44. The method of claim 42, wherein sending messages includes:
counting a frame loss for the first message if the station fails to receive an ACK frame from the access point for the first message and if a retry limit has been reached.

45. The method of claim 42, wherein said sending messages includes:
sending a second message from the station to the access point after receiving an ACK frame at the station for the first message or counting a frame loss for the first message.

46. The method of claim 41, wherein the messages and ACK frames are sent according to the IEEE 802.11 standard.

47. A system for measuring the throughput of transmissions over a wireless local area network, the system comprising:
a station configured to:
send messages to an access point during a test period,

wherein the messages are sent as data frames,
receive acknowledgements from an access point during a test
period,
wherein the acknowledgements are received as control
frames,
determine a throughput for a test period based on the
acknowledgements received from the access point during the test period; and
an access point configured to:
receive messages from the station,
wherein the messages are received as data frames,
send acknowledgements to the station for each message received
from the station,
wherein the acknowledgements are sent as control frames.

48. The system of claim 47, wherein the station is further configured to resend a message to the access point if the station fails to receive an acknowledgement for the message from the access point and if a retry limit has not been reached.

49. The system of claim 48, wherein the station is further configured to:
count a retry for each message that is resent, and
display a number of retries counted during a test period.

50. The system of claim 47, wherein the station is further configured to:
count a frame loss when the station fails to receive an acknowledgement for a message sent by the station and when a retry limit has been reached for the message, and
display a number of frame losses counted during a test period.

51. The system of claim 47, wherein the station is further configured to send the messages sequentially, such that the station is configured to send a second

message after receiving an acknowledgement or counting a frame loss for a previously sent first message.

52. The system of claim 47, wherein the station configured to determine a throughput for a test period is further configured to determine a throughput in bits per second based on a test period, a number of acknowledgements received at the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.

53. The system of claim 47, wherein the station is further configured to:
send a request to send frame to the access point before sending a message,
and
receive a clear to send frame from the access point before sending a message.

54. The system of claim 53, wherein the access point is further configured to:
receive a request to send frame from the station, and
send a clear to send frame to the station.

55. The system of claim 47, wherein each message includes a header having a destination address set to the access point, a BSSID set to the access point, and a source address set to the station.

56. The system of claim 55, wherein each message further includes a header having a destination service access point set to a null service access point.

57. The system of claim 47, wherein the station is further configured to:
receive messages from the access point; and
send acknowledgements to the access point.

58. The system of claim 57, wherein the access point is further configured to:
send messages to the station after receiving the messages from the station;
and
receive acknowledgements from the station.

59. The system of claim 57, wherein the station is further configured to
determine a throughput from the access point to the station for a test period based
on the number of messages received from the access point during the test period.

60. The system of claim 47, wherein the station and the access point are
configured to send and receive data frames and control frames at a layer below a
network layer.

61. The system of claim 47, wherein the station and access point are
configured to send and receive data frames and control frames at a data link layer.

62. The system of claim 47, wherein the station and access point are
configured to send and receive data frames and control frames according to an
IEEE 802.11 standard.

63. The system of claim 47, wherein the station is further configured as a
diagnostic tool.

64. The system of claim 47, wherein the station is further configured as an
administrative tool.

65. A computer-readable storage medium containing computer executable
code to measure the throughput of transmission from a station to an access point
over a wireless local area network by instruction the computer to operate as
follows:

 sending messages from the station to the access point during a test period,

wherein the messages are sent as data frames;
receiving acknowledgements at the station from the access point,
wherein the acknowledgements are sent to the station as control
frames for each message received by the access point; and
determining a throughput for the test period based on the number of
acknowledgements received at the station from the access point during the test
period

66. The computer-readable storage medium of claim 65, wherein sending
messages includes:

sending a first message from the station to the access point, and
determining if an acknowledgement for the first message has been
received at the station.

67. The computer-readable storage medium of claim 66, wherein sending
messages includes:

resending the first message if the station fails to receive an
acknowledgement from the access point and if a retry limit has not been reached.

68. The computer-readable storage medium of claim 67, further comprising:
counting a retry for each message that is resent.

69. The computer-readable storage medium of claim 66, wherein sending
messages includes:

counting a frame loss for the first message if the station fails to receive an
acknowledgement for the first message from the access point and if a retry limit
has been reached.

70. The computer-readable storage medium of claim 66, wherein said sending
messages includes:

sending a second message from the station to the access point after receiving an acknowledgement at the station for the first message or counting a frame loss for the first message.

71. The computer-readable storage medium of claim 65, wherein determining a throughput for the test period further comprises determining the throughput in bits per second based on the test period, the number of acknowledgements received at the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.

72. The computer-readable storage medium of claim 65, further comprising:
sending a request to send frame from the station to the access point before sending each message; and
receiving a clear to send frame at the station from the access point before sending each message.

73. The computer-readable storage medium of claim 65, wherein each message includes a header having a destination address set to the access point, a BSSID set to the access point, and a source address set to the station.

74. The computer-readable storage medium of claim 73, wherein each message further includes a header having a destination service access point set to a null service access point.

75. The computer-readable storage medium of claim 65, further comprising:
receiving messages at the station from the access point,
wherein the access point sends the messages to the station after receiving the messages from the station;

determining a throughput from the access point to the station for the test period based on the messages received by the station from the access point during the test period.

76. The computer-readable storage medium of claim 75, wherein determining a throughput from the access point to the station for the test period further comprises determining the throughput in bits per second based on the test period, the number of messages received at the station from the access point during the test period, and a number of bits included in each of the messages sent from the station to the access point during the test period.